



Ron Larsen, Van Cleave Photography

A Honeybee Worker hovers over a flower, sucking up nectar with its tongue. These bees also gather pollen, which they carry in areas called *baskets* on their hind legs.

BEE

BEE is an insect that lives in almost every part of the world except near the North and South Poles. There are 10,000 *species* (kinds) of bees, but only honeybees make honey and wax that man can use. Bees are the only insects that produce food eaten by man. We use the wax from the nests of bees in making such products as candles and lipsticks. We use their honey in cooking and as a sweet spread on bread.

When bees fly from flower to flower, they help both man and the blossoms they visit. Many fruits and vegetables would die out if bees did not help fertilize flowers. Bees gather nectar and pollen from flowers. They make honey from the nectar and use the honey and pollen as food.

Some people are afraid of bees because they sting. But bees do not sting unless they are frightened or hurt. Like most other insects, bees have three pairs of legs and four wings. A bee has a special stomach, called a *honey stomach*, in which it carries nectar to the nest.

Honeybees are *social insects*. They live and work together in large groups. They form a *colony* (group) of

thousands of bees. A single honeybee may live only a few weeks or months, but the colony may go on living for many years. One worker bee can do little by itself, but the many thousands of workers in a colony, working as a group, can do many things. They fly into the fields and woods to gather food and water. They build their own home in a box, a hollow tree, or a bee hive. They store honey and pollen and eat it in winter, just as squirrels eat the nuts they store. Honeybees even air-condition their hive to keep it warm or cool.

The Honeybee Colony

Each colony includes three classes of honeybees: (1) the *queen*, which lays eggs; (2) the *workers*, which gather food and care for the young; and (3) the *drones*, which fertilize the queen.

The honeybee colony is really a family home, where the workers provide food and shelter for the helpless young. The workers build the nest, collect and store honey, and do all kinds of housekeeping work. They guard the entrance to the nest against enemies. If necessary, they fight and die to protect the colony.

Men have studied the honeybee for hundreds of years. But we still do not know how the worker bees



Worker



Queen

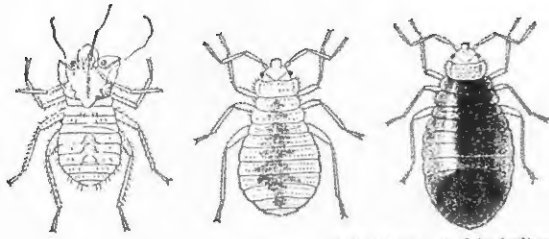


Drone

WORLD BOOK Illustrations by James Teason

Three Kinds of Bees make up a honeybee colony. The colony consists of thousands of workers, one queen, and a few hundred drones.

BEDSTRAW



U. S. Department of Agriculture

Bedbugs Molt (shed the outer layer of skin) five times before maturity. Bedbugs are shown above: *left*, before the first molt; *center*, just after the first molt, in the second larval stage; and *right*, after eating, during the second larval stage.

homes (use smoke fumes or special insecticide fumes) to kill or drive out bedbugs. Cyanide gas is probably the most effective fumigating agent for this purpose.

Scientific Classification. Bedbugs belong to the order *Hemiptera* and the bedbug family, *Cimicidae*. The common bedbug that attacks man and animals is genus *Cimex*, species *C. lectularius*. DONALD J. BORROR

BEDE, *beed*, or *BAEDA* (673?-735), also known as **THE VENERABLE BEDE**, was an English historian and *theologian* (one who studies God and religion). Bede's writings on history, science, and theology are regarded as the most intelligent summary ever prepared of Western knowledge in the 600's and 700's. Scholars consider his *Ecclesiastical History of the English Nation* (731) the finest historical work of the early Middle Ages. It is our main source for English history up to that time, and it earned Bede the title, *The Father of English History*. Bede's *History* has a simple and direct style, and it includes colorful and interesting tales.

Bede was born in northeastern England, and studied at the monasteries of Wearmouth and Jarrow. Like most educated men of his time, Bede became a monk. He devoted his life to scholarship at Jarrow. Bede understood Greek and probably some Hebrew, and he was familiar with the writings of such earlier theologians as Ambrose, Augustine, Gregory, and Jerome. BYRCE LYON

BEDFORD, GUNNING, JR. (1747-1812), an American statesman, was a Delaware signer of the United States Constitution. He served as attorney general of Delaware from 1784 to 1789, and was a U.S. district judge from 1789 to 1812. Bedford was born in Philadelphia, and was graduated from Princeton College. He studied law in Philadelphia, and was admitted to the bar. He settled in Delaware, and was a delegate to the Congress of the Confederation in 1785 and 1786, the Annapolis Convention in 1786, and the Constitutional Convention in 1787. Gunning Bedford, Jr., is often confused with his cousin Gunning Bedford, Sr. (1742-1797). His cousin served as governor of Delaware from 1796 until his death in 1797. KENNETH R. ROSSMAN

BEDFORD FLAG. See **FLAG** (color picture: Flags in American History [New England Flags]).

BEDLINGTON TERRIER is a dog that looks somewhat like a lamb. It has a soft, fleecy coat, and the topknot on its head is trimmed so that its face looks like a sheep's face. The Bedlington has long legs and a slender body. For dog shows, the American Kennel Club requires Bedlingtons to weigh from 17 to 23 pounds (7.7 to 10.4 kilograms). Its coat is blue or liver in color, and may have tan marks. The dog is named for Bedlington, Eng-

land. It came from Bedlington in 1825. Originally, it was raised to fight badgers. It is related to the otter hound, Dandie Dinmont, and whippet. JOSEPHINE Z. RINE
See also **DOG** (color picture: Terriers).

BEDLOE'S ISLAND. See **LIBERTY ISLAND**.

BEDOUINS, *BEHD u ihns*, or **BEDAWINS**, are Arab animal herders who live in the deserts of the Middle East. They move from place to place, taking their camels, goats, and sheep to fresh pastureland. Bedouins live on the meat and dairy products of their animals, but sometimes they rob their settled non-Bedouin neighbors. Almost all Bedouins are Muslims and speak some form of the Arabic language.

Before the A.D. 600's, the Bedouins lived mainly in Arabia. Their tribes were fiercely independent and often feuded with one another. Islam, the Muslim religion, developed in Arabia during the early 600's and temporarily unified the Bedouins. Bedouins fought in the Muslim armies that conquered Egypt, Iraq, and Syria in the 630's and 640's. But after 650, the Bedouins began to resume their independent lives.

During the late 1000's, Bedouin warriors invaded North Africa and destroyed many Arab and Berber communities. These invaders remained in the region and became the ancestors of the North African Bedouins of today. JOHN MIDDLETON

See also **EGYPT** (Village Life); **SAUDI ARABIA** (Way of Life; picture).

BEDSTRAW is one of a group of plants that were once used for mattresses. They are slender herbs with square stems. Their leaves grow in *whorls* (circles) of four to eight at each joint of the stem. The tiny white or brownish flowers have three or four petals. The seed pod, often bristly, has two ball-shaped sections that split apart when ripe. Each section contains one seed.

Bedstraws grow wild in woods and marshes. They are often cultivated in gardens and used in bouquets because of their delicate appearance. Some kinds were once used to curdle milk in making cheese.

Scientific Classification. Bedstraws belong to the madder family, *Rubiaceae*. They are classified in the genus *Galium*. RICHARD W. POHL

Clusters of Tiny Bedstraw Flowers top the long, slender stems. The plant makes an attractive border for flower gardens. J. Horace McFarland



know what to do or when to do it. We do not know how the workers decide when to build more honeycomb, how they know when the developing bees need more food, or how they decide to start queen cells in which to raise new queen bees.

The Nest. To build a *hive* (a nest with storage space for honey) the worker honeybees make some beeswax and shape it into a waterproof *honeycomb*. The honeycomb is a mass of six-sided compartments called *cells*. As soon as the workers have completed a few cells, the queen lays eggs in them. The workers enlarge the colony by building more cells, and the queen lays more eggs. Some workers fly out to gather nectar and pollen from flowers. See NECTAR; POLLEN AND POLLINATION.

The cells containing eggs and developing bees are in a round area in the center of the nest. This area is called the *brood nest*. The bees store pollen in cells above and on the sides of the brood nest. They put the nectar in cells above the pollen, where it later changes into honey.

The Queen honeybee lays the eggs that hatch into thousands of workers. Laying eggs is the queen's only job. She does not gather food or help build the nest. The workers feed her and care for her. The queen honeybee does not rule the colony, but she is the force that holds it together. The workers become excited and disorganized if she is not in the nest.

The Workers do all the chores in a honeybee colony except lay eggs. All workers are females, like the queen, but they are smaller than the queen. The worker has a long tongue for gathering nectar. It uses its hind legs to carry pollen.

The youngest workers clean empty cells, care for the young, help build the comb, and take care of the nectar. When a worker is 10 days to two weeks old, it flies to the fields where it collects nectar, pollen, and water for the young in the hive. On its outward flight, the worker flies here and there in search of food. When it has gathered as much as it can carry, it takes the *beeline* (shortest route) back to the hive. During the busy summer season, a worker usually lives about six weeks. It may live several months during the cold weather of fall, winter, and spring, when it has less work to do.

A worker returning to the nest from a food hunt uses a "dance" to tell its neighbors where food is. When the flowers are near the nest, the worker dances in circles. This dance stirs the others and they fly off to find the flowers. When the flowers are far from the nest, the worker dances in the direction of the flowers so the rest will know where to fly.

Several workers always stand guard at the nest entrance. All the bees in any hive have their own *hive odor*. The guards can tell when a stranger alights at the entrance, because it smells different. They attack and try to kill strange workers or strange queens, but they do not bother strange drones. Certain workers at the entrance fan fresh air into the hive, and force out the stale air. In winter, the workers gather in a loose cluster over the cells of honey. The movement of the workers' wings helps produce enough heat to keep the cluster and its queen at a temperature of about 50° to 60° F. (10° to 16° C). In summer, the air temperature in the brood area usually rises to around 93° F. (34° C).

Drones, or male honeybees, are burly, clumsy creatures. They do no work, and have no sting. They are raised in cells a little larger than those used for worker bees. Drones develop from unfertilized eggs. The only function of a drone is to mate with a young queen. An unmated queen can lay only drone eggs. She must be fertilized in order to lay worker eggs. Most drones are raised in late spring and early summer. In autumn, when the honey flow is over, the workers let the drones starve to death. This is done because they are no longer useful and would eat too much of the stored honey.

Enemies of bees include bears and Argentine ants. These and other thieves may destroy the hive in their search for honey. Skunks and dragonflies often eat worker bees. The wax moth may ruin a weak colony by eating the wax in the honeycomb. Worker bees try to protect the colony by stinging invaders to death, but they do not always succeed. An insect called the *bee assassin* makes a specialty of feeding on bees that it catches in flowers. Young and adult bees sometimes fall victim to such diseases as European foul brood and American foul brood. These diseases turn the young bees into a gummy, lifeless mass. Insecticides that are meant to kill other insects kill thousands of bees each year. Weed sprays take away an important source of bee

INTERESTING FACTS ABOUT BEES

Fossil Bees found trapped in amber probably lived 50,000,000 years ago.

A Honeycomb has walls that are only $\frac{1}{32}$ inch (0.3 millimeter) thick, but can support 30 times their weight.

The Largest Bee is a kind of bumblebee that is over 1 inch (2.5 centimeters) long. The largest honeybee, the oriental hive bee, is $\frac{3}{4}$ inch (19 millimeters) long.

Size of a Bee Colony. A strong, healthy colony may contain between 50,000 and 60,000 bees.

The Smallest Bee is *Trigona minima*, a stingless bee only $\frac{1}{16}$ inch (2 millimeters) long. The dwarf bee, the smallest honeybee, is under $\frac{1}{8}$ inch (10 millimeters).

Speed. Bees fly about 12 miles (19 kilometers) per hour.

Stinging requires a bee to use 22 different muscles.

Taste. Honeybees can identify a flavor as sweet, sour, salty, or bitter.

A Worker honeybee collects enough nectar in its lifetime to make about $\frac{1}{16}$ pound (45 grams) of honey.



E. R. Degginger

Workers Store Nectar and Pollen in some cells of the honeycomb. Other cells hold eggs and developing bees. One square inch (6.5 square centimeters) of honeycomb has about 25 cells.

BEE

STAGES IN THE LIFE OF A BEE



Egg laid
by queen



Grub fed
by worker



Full-grown
bee grub



Grub sealed
in its cell



Grub becomes
a pupa



Young adult
leaves cell

WORLD BOOK illustrations by James Teason

food. The improper use of insecticides and weed sprays drives bees away from certain areas in the United States.

Life of the Honeybee

From Egg to Larva. Honeybee eggs are pearly white and about as big as the dot over this *i*. A bee starts to develop as soon as the queen lays the egg. After three days, a tiny wormlike *larva* crawls out of the egg. The workers place larval food, called *royal jelly*, in the bottom of each cell. Royal jelly is a creamy substance, rich in vitamins and proteins. It is formed by glands in the heads of young worker bees. When the larva is three days old, the workers begin feeding it a mixture of honey and pollen called *bee bread*.

The workers build a wax cap over the cell five days

after the larva hatches. A great change then takes place. The wormlike larva becomes a *pupa*, then the pupa develops into an adult. The adult worker bee bites its way out of the cell 21 days after the egg is laid. Then it begins to work in the hive. Drones take 24 days to develop fully. See **LARVA; PUPA**.

Growth of the Queen. A colony needs a new queen if the old queen disappears or becomes feeble, or if the old queen and part of the colony decide to leave and build a new hive.

In some unknown way, the workers select a few larvae to become queens. They feed these larvae only royal jelly. At the same time, other workers build special cells for the queens to grow in. A queen cell looks somewhat like half a peanut shell hanging from the

HIVE LIFE IN SPRING AND SUMMER

Bees perform a variety of jobs in warm weather. Nurse bees, *left*, clean the empty cells and care for the grubs. The queen, *center*, lays eggs, one in a cell. Workers defend the hive by stinging an invading wasp to death, *bottom center*. Field workers, *right*, return to the hive loaded with nectar and pollen. Bees at the entrance to the hive fan in fresh air with their wings, *bottom right*.

WORLD BOOK illustration by James Teason



honeycomb. About $5\frac{1}{2}$ days after hatching, the queen larva becomes a pupa. The young adult queen crawls out of the cell 16 days after the egg is laid. Scientists believe the bees may add a special substance to the queen's royal jelly to make her grow faster and have a different appearance from the workers.

Mating Flight. When the young queen emerges from her special cell, the bees in the colony pay little attention to her. She eats honey and gains in strength. If two queens hatch at the same time, they fight until one stings the other to death. The old queen may leave the colony, or she may fight with the young queen. After she has killed her rivals, the young queen flies from the hive. She may mate with one or sometimes several drones on her first flight or on a later flight. The young queen returns to the hive after she has mated, and begins to lay eggs two days later. After mating with only one drone, she can lay eggs for the rest of her life. A queen may live as long as five years. She may lay 2,000 eggs a day, more than 200,000 in a single season, and up to 1,000,000 eggs in her lifetime.

Swarming. When a colony becomes overcrowded, the old queen stops laying eggs. The workers build cells for new queens, and about four days later cover the cells with wax. A few days after the new queen cells are covered over with wax, many of the workers and the old queen leave the hive as a *swarm*. Their flight to form a new colony is called *swarming*. Some workers stay behind in the hive in order to care for the larvae and the new queen.

The swarm clusters around a branch or a post after



Glen Sherwood

A Bee Swarm may include thousands of bees. They crowd around a branch while scouts search for a site to build a new hive.

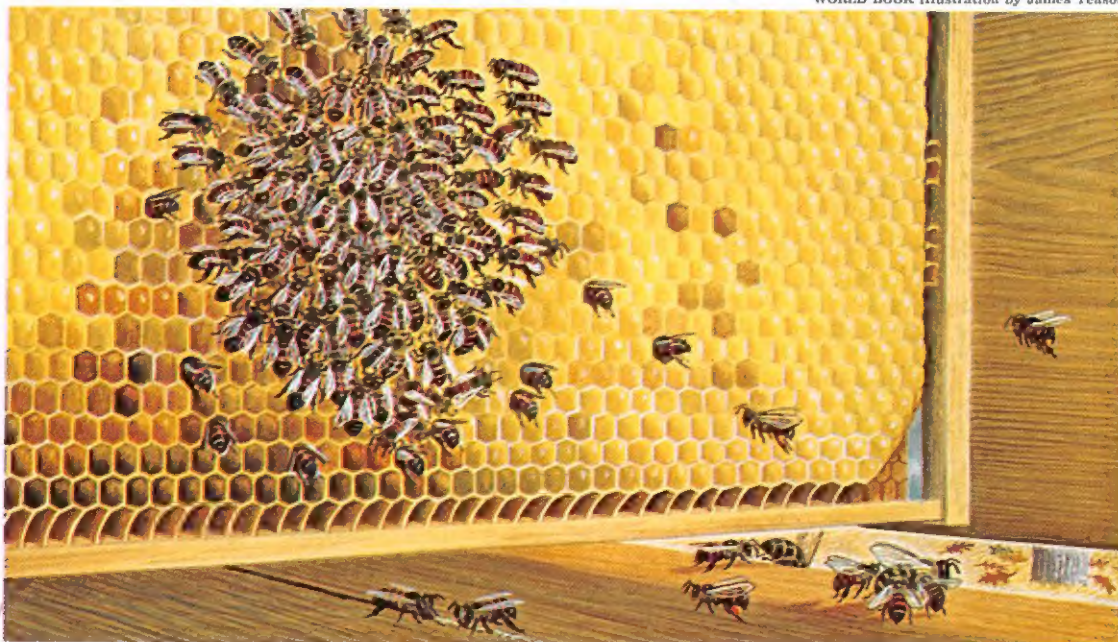
leaving the hive. Scouts then seek out a location for the new colony. Some scouting may have occurred before the swarm left the hive. After deciding on a location, the swarm flies off to build its new nest.

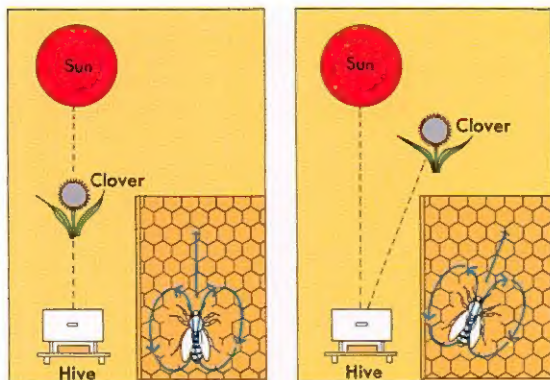
Making Honey. Flowers have special glands, called *nectaries*, that produce nectar. Worker honeybees suck up nectar from the flowers with their long tongues, and store it in their honey stomachs. When the worker has

HIVE LIFE IN FALL

As cold weather sets in, the queen and workers cluster together on the honeycomb for warmth. They feed on honey that the colony stored up during the spring and summer. In this picture, the bees have already eaten the honey that had been stored in some of the cells, *bottom left*. Some workers, *right*, collect food out of full cells. Others, *bottom right*, push the drones out of the hive.

WORLD BOOK illustration by James Tesson





WORLD BOOK diagram

A Field Worker Dances a Figure-8 Pattern to show the location of distant nectar. The line between the loops of the 8 indicates the position of the nectar in relation to the sun.

filled its honey stomach with a small drop of nectar, it returns to the hive. There it sucks the nectar back through its mouth. It either gives the nectar to other bees or puts it in an empty cell in the hive.

When nectar is in a bee's stomach, certain chemicals are added to it. In the honeycomb, the water in the nectar evaporates and these chemicals change the nectar into honey. Workers then put wax caps on the honey-filled cells. A beekeeper collecting honey may remove some of the combs. But he must leave enough in the hive to feed the bees. See HONEY.

Making Wax. Special glands in the abdomens of young workers produce beeswax. The wax oozes through small *pores*, or holes in the body, and forms tiny white flakes on the outside of the abdomen. A bee usually makes eight flakes at a time. The bee picks them off its abdomen with its legs and moves them up to its jaws. After chewing the wax, the bee puts the wax on the part of the honeycomb that it is building. The bee produces beeswax only when it needs the wax to build a honeycomb. See BEESWAX.

Bee Glue, or *propolis*, is a sticky substance that worker bees collect from some kinds of trees. They carry it home on their hind legs, and use it as a sort of cement to repair cracks in the hive.

The Body of the Honeybee

The honeybee, like all insects, has a body that is divided into three sections: the *head*, the *thorax*, or chest, and the *abdomen*. Honeybees range in color from black to shades of light brown. The bee's body is thickly covered with fine hairs. When a bee travels from flower to flower, grains of pollen stick to these hairs.

Eyes. A bee has five eyes—three small ones in a triangle on top of its head, and a large *compound* eye on each side of the head. Each compound eye is made up of thousands of single eyes crowded close together.

We do not know how far a bee can see or how it finds flowers. It apparently learns certain landmarks to guide it back to the hive. Bees can distinguish blue, yellow, and ultraviolet. But they cannot focus their eyes, because the eyes have no pupils.

Antennae are slender, jointed feelers attached to the front of the bee's head. They have tiny sense organs that provide a means of smelling. Tiny hairs on the antennae probably serve as organs of touch.

Mouth. The bee uses its *tongue* to suck water, nectar, and honey into its mouth. The tongue is a flexible tube on the outside of the bee's head. It can be shortened, lengthened, and moved in all directions. On the sides of the tongue are the two jaws. The bee uses its jaws as tools to grasp wax and pollen.

Head glands that empty into the mouth produce the chemicals that bees add to nectar. Strong muscles are attached to the inside walls of the mouth. A bee sucks nectar up its tongue, through its mouth, and into its honey stomach. It can also reverse this process and bring food from its stomach out through its mouth. In this way, workers put nectar into wax cells, or give it to other bees.

Wings. One pair of the bee's four thin wings is on each side of the thorax. The front wing of each pair is larger than the hind wing. When the bee flies, the two wings of a pair are coupled together by a row of tiny hooks, and act as one wing.

The wings can move up and down, and forward and backward. A bee can fly forward, sideways, or backward, and can hover in one place in the air.

Legs. A bee has three legs on each side of the thorax. Each leg has five main joints, plus tiny segments that make up the foot. The worker bee uses its legs for walking, and as tools to handle wax scales and to brush pollen off its body. It carries pollen and propolis on its hind legs.

Each front leg has a special notch and spur called the *antenna cleaner*, with which the bee cleans dirt from its antennae. On the outside of each of the worker's hind legs is a smooth area surrounded by stiff hairs. This area is called the *pollen basket*, and is used to carry pollen. Rows of hairs on the inside of the hind legs help load the pollen in the pollen basket. When the worker returns to the hive, it places its hind legs down into a cell and kicks off the pollen. Another worker uses its head to flatten out the pollen on the bottom of the cell.

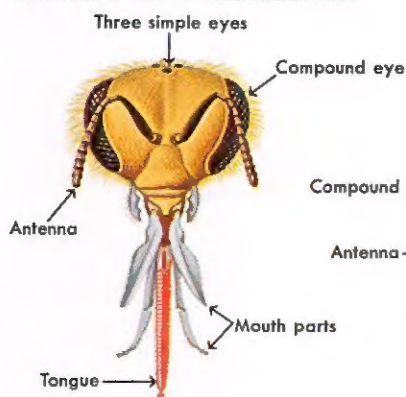
Sting. Most bees depend on their stingers, or stings, as their only means of self-defense. Glands attached to the sting produce a *venom* (poison) made up of complex chemical substances.

The stinger of the worker bee is straight, with *barbs*, or hooks, on it. When the bee thrusts the sting into flesh, the barbs hold tight, and the stinger pulls out of the bee's body. But muscles inside the sting keep working and force it deep into the wound. At the same time, muscles pump more poison down the sting. A worker bee dies a few hours after losing its sting.

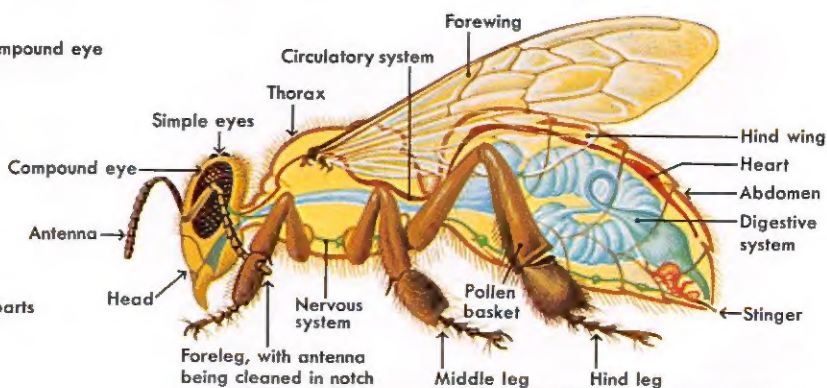
The queen bee has a smooth, curved sting which she uses only to kill other queens. Queens do not lose their stings as do workers. Drones have no stings.

A bee sting causes sudden pain, and the poison produces continued pain and swelling. If you are stung by a bee, scrape the stinger off immediately. Do not pinch or squeeze the stinger. Scraping the stinger reduces the amount of poison that enters the wound. Some persons are so sensitive to bee stings that they may die from

THE HEAD OF A WORKER BEE



THE BODY OF A WORKER BEE



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only one sting unless a doctor treats them quickly.

During the 1970's, U.S. scientists became concerned that swarms of vicious South American "killer bees" might spread to North America. If their nest is disturbed, these bees attack anything that moves. They attack in large numbers, and their stings have killed a few persons and some animals. These South American bees developed in Brazil in the late 1950's and early 1960's. A researcher had imported some aggressive African honeybees because such bees produce large amounts of honey. Some of the colonies escaped, and some of their queens mated with local drones. The resulting hybrids have spread rapidly throughout much of South America.

These bees may reach the United States by 1990. However, scientists who have studied the South American bees predict that those that reach the United States may be considerably less aggressive. These bees may lose much of their ferocity through mixing with the domesticated bees of Mexico.

Kinds of Bees

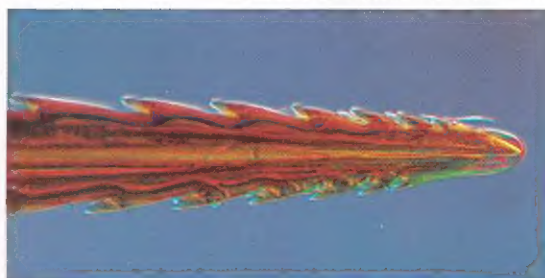
Scientists divide the 10,000 kinds of bees into two main groups. *Social bees* live in colonies, while *solitary bees* live alone. Most kinds of bees are solitary.

Social Bees live in colonies that have as few as 10 or as many as 80,000 members. Honeybees, described earlier in this article, seem to have the most highly developed societies. Stingless bees and bumblebees come next after honeybees in social development.

Stingless Bees have small stings, but do not use them as weapons. They prefer to bite with their jaws. Stingless bees live only in tropical and near-tropical areas. They are not found in the United States.

The largest kind of stingless bee is about as big as a honeybee, and the smallest is about the size of a mosquito. Stingless bees build their nests in trees, on walls, in crude hives, in the ground, or in open areas. They build their honeycombs in horizontal layers. An outer wall surrounds the nest except for a small entrance. Colonies may have from 50 to several thousand bees.

Some of the larger stingless bees store honey. But much of this honey cannot be used for food because it is poisonous or has a disagreeable taste.



Eric Gravé

A Barbed Stinger, magnified about 200 times, grows from the end of a worker bee's body. The bee uses it for self-defense.

Bumblebees live in colonies of 50 to several hundred bees. Their honey has a strong flavor. See **BUMBLEBEE**.

Solitary Bees live alone. But sometimes thousands of solitary bees gather in a small area and build their nests close together. There are no workers among the solitary bees. Each female is like a queen that does her own work. She builds her own nest and stores pollen and nectar in it. Then she lays an egg on the pollen in each of the cells, seals the nest, and flies away. When the eggs hatch, the larvae eat the stored food. The most important kinds of solitary bees are the carpenter, leaf-cutter, miner, mason, and cuckoo bees.

Carpenter Bees build their nests in dead twigs or branches. The female digs a tunnel, puts pollen and nectar at the bottom, and lays an egg. She spreads tiny wood chips cemented together with saliva across the top of the cell. This ceiling acts as a floor for the cell above. The tunnel has a series of cells, each containing food and one egg.

Leaf Cutter Bees cut out pieces of leaves and pack them into small nests in tunnels. They lay eggs on food which they put into the nests. They may build their tunnels in the ground, in branches, or in pieces of soft wood. A tunnel may have six or more cells, one above the other.

Mining Bees usually dig tunnels in the ground. Some kinds show the beginnings of social living. After a few bees dig out a main tunnel, each female digs a small, short tunnel in the side walls. She provides this short tunnel with pollen and nectar, and lays an egg on the

FIVE KINDS OF BEES

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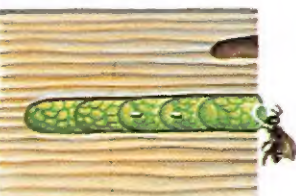
Stingless Bees often build their nests in hollow tree trunks. Colonies of these social bees may have from 50 to several thousand members. They live only in tropical and semitropical areas.



The Carpenter Bee bores a tunnel in wood for its nest. It divides the tunnel into several cells, separated by wood chips mixed with saliva. Each cell contains an egg and some food.



The Leafcutter Bee also nests in tunnels. It fills the tunnels with cells made of small pieces of leaf mixed with saliva.



The Mining Bee burrows into loose ground to make its nest. Mining bees are considered solitary insects, but many share the same main tunnel to the surface of the ground.



The Mason Bee sometimes builds its nest on a stone wall. The nest consists of several cells made of clay and saliva.



food. Some kinds of mining bees post a guard at the entrance to the main tunnel. This guard bee attacks any strangers.

Mason Bees sometimes build their nests in decaying wood or in snail shells. One kind strengthens the snail shell with its saliva and broken pieces of shell. The female puts food in the shell, lays an egg, and buries the whole nest in the ground. Another kind of mason bee builds its nest on a wall or large stone. It gathers clay, moistens it with saliva, and forms cells that stick out from the wall. The female provides the cells with food and lays an egg in each. Then she covers the group of cells with a mixture of clay and saliva. The clay hardens and protects the eggs.

Cuckoo Bees seem unable to build their own nests. They cannot provide food for their young, because they have no pollen baskets on their hind legs. Some kinds of cuckoo bees lay their eggs in the nests of other solitary bees. The cuckoo bee larvae usually emerge first and eat the food before the other larvae hatch. Another kind of cuckoo bee enters a bumblebee nest and kills the queen. The workers accept the cuckoo bee as queen. She lays her eggs and the workers take care of them. Young cuckoo bees leave the nest when they are adults.

Beekeeping

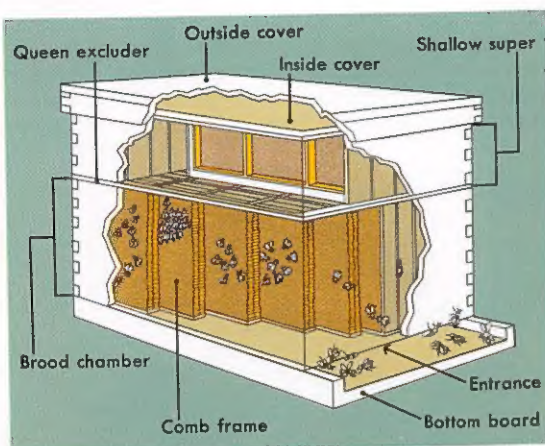
The people of the Stone Age, thousands of years ago, ate honey that they stole from the hives of wild bees. Some of these people learned to make crude hives for the bees, so the honey would be near their homes. They probably made these first beehives out of hollow logs with sticks inside to support the honeycombs. Later, farmers in Europe built straw *skeps* that looked like baskets turned upside down. Colonists probably took honeybees with them from England to Virginia in 1622. Swarms of these honeybees escaped from their hives and built new nests in the woods. The settlers took honeybees with them as they moved west.

As an industry, beekeeping is most highly developed in the United States, Canada, and Australia. Farmers who keep hives of bees can sell the honey and beeswax. The bees also aid the farmer by pollinating many of his crops. Commercial beekeeping, also called *apiculture*, began in the 1880's. Men learned to manage enough colonies to depend on the honey crop as a means of livelihood.

Today, beekeepers in the United States tend about 4 million hives. They sell about 206 million pounds (93 million kilograms) of honey every year. Bakers buy large amounts of honey to use in crackers, cookies, and other baked goods. The rest is packaged in small containers and sold for cooking and as a sweet spread.

About 4 million pounds (1.8 million kilograms) of beeswax is produced and sold in the United States every year. Beeswax is used in candles, lipsticks, polishes, waterproofing compounds, and other products.

Most beekeepers provide *standard hives* for their bees. The hives are made up of several removable drawerlike *supers* (sections). The bees build their honeycombs inside the supers on movable frames that hang $\frac{3}{8}$ inch (10 millimeters) apart. Bees can pass through this *bee space* to all parts of the hive, and the beekeeper can move the



WORLD BOOK diagram

A Standard Hive consists of removable drawerlike sections. The queen remains in the brood chamber, but the workers can pass through the queen excluder to store nectar in the shallow super.

frames about. Each super holds 10 combs, and each comb contains about 6,600 cells.

Beekeepers keep from 40 to 75 hives in one location. If they have more colonies, they use *out-apiaries* (locations) several miles or kilometers apart. The out-apiaries must be separated so that there are enough plants nearby to supply nectar. A colony can gather 20 to 25 pounds (9 to 11 kilograms) of nectar in a day.

Beekeepers must learn to handle their bees carefully so the bees will not sting them. Slow, deliberate movements do not disturb bees as much as quick movements. Beekeepers usually wear veils of wire screen or cloth to protect their faces. They tie their clothing at the wrists and ankles. But most beekeepers do not wear gloves. Gloves are clumsy and soon become covered with sticky honey and propolis from the hive.

Some beekeepers in the southern United States sell packages containing workers and a queen to honey producers. They usually ship 2 to 5 pounds (0.9 to 2.3 kilograms) of bees in wire-screen packages. Other beekeepers rent hives of bees. Farmers place the rented hives in or near fields, and the bees pollinate the crops.

As a Hobby. Many persons are more interested in studying bees and their habits than they are in gathering honey. They often keep bees in a glass-walled hive, where they can watch workers communicate with each other by dancing, and see the queen laying eggs while workers care for the young.

Bees can be kept in both city and farm areas. People keep hives in back yards, on roofs, or even in attics. Honeybees are easy to handle, and their honey may be eaten or sold. The beginner must buy his bees either as a package of workers and a queen, or as a complete hive. He should have his colony inspected by the state bee inspector to make sure it is free of disease.

Scientific Classification. Bees belong to the order *Hymenoptera*, or membrane-winged insects. They make up the superfamily *Apoidea*. The order *Hymenoptera* also includes ants and wasps.

Honeybees make up the family *Apidae*. The common honeybee is genus *Apis*, species *A. mellifera*. Stingless bees



Annan Photo

Beekeepers wear protective veils. Light-colored clothes help provide protection from stings. Most experienced beekeepers handle the bees and honeycombs with their bare hands.

are closely related to the honeybees. They belong to the family *Meliponidae*. Bumblebees are members of the family *Bombidae* and the genus *Bombus*.

Carpenter bees belong to the genera *Xylocopa* and *Ceratina*. Mason bees are in the genera *Osmia* and *Chalcidoma*. Leafcutter bees are in the genus *Megachile*. Cuckoo bees belong to the families *Haliictidae*, *Megachilidae*, and *Anthopharidae*. Mining bees belong to the family *Andrenidae*.

EVERETT OERTEL

Related Articles in WORLD BOOK include:

Balm	Fossil (picture)	Larva
Beeswax	Honey	Pollen and Pollination
Bumblebee	Hymenoptera	Pupa
Clover	Insect (pictures)	

Outline

- I. **The Honeybee Colony**
 - A. The Nest
 - B. The Queen
 - C. The Workers
 - D. Drones
 - E. Enemies
- II. **Life of the Honeybee**
 - A. From Egg to Larva
 - B. Growth of the Queen
 - C. Mating Flight
 - D. Swarming
 - E. Making Honey
 - F. Making Wax
 - G. Bee Glue
- III. **The Body of the Honeybee**
 - A. Eyes
 - B. Antennae
 - C. Mouth
 - D. Wings
 - E. Legs
 - F. Sting
- IV. **Kinds of Bees**
 - A. Social Bees
 - B. Solitary Bees
- V. **Beekeeping**
 - A. As an Industry
 - B. As a Hobby

Questions

- What is the main duty of the queen bee?
- How do bees keep fresh air in the hive?
- How are bees important to the farmer?
- Which members of a honeybee colony have no stings?
- Which members produce beeswax?
- How do bees guard their colonies against strangers?
- What food makes a young worker larva become a queen?
- How do bees keep warm in winter?
- Why do the workers allow the drones to starve to death in the fall?
- Why can a worker bee sting only once?
- How many eggs can a honeybee queen lay in a day?

BEE-EATER

BEE-EATER. See BIRD (picture: Birds of Other Lands).

BEE FLY. See BEEFLY.

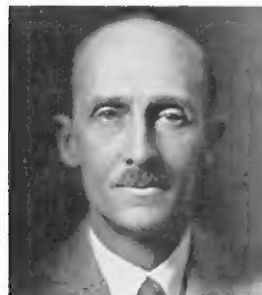
BEE MARTIN. See KINGBIRD.

BEEBE, LUCIUS MORRIS (1902-1966), an American author and newspaperman, became known for his books about Nevada and the West. From 1951 to 1961, he was co-owner of *The Territorial Enterprise*, a Virginia City, Nev., newspaper. He wrote several books on railroading, including *High Iron*; *A Book of Trains* (1938). Beebe also wrote *Comstock Commotion: The Story of The Territorial Enterprise and Virginia City News* (1954). He was born in Wakefield, Mass.

BEEBE, BEE bee, WILLIAM (1877-1962), was a well-known American naturalist and writer. He gained fame for his vivid accounts of tropical jungles, his explorations into the depths of the sea, and his studies of birds,

especially pheasants. He became curator of ornithology (bird study) at the New York Zoological Society in 1899. He helped found the Society's Tropical Research Department in 1916, and became the director of this department.

Beebe conducted expeditions to Borneo, British Guiana (now Guyana), and Trinidad. His many books include *Jungle Peace* (1918) and *Half Mile Down* (1934), in which he tells of



Wide World

William Beebe

his undersea adventures in a bathysphere. He also wrote *Beneath Tropic Seas* (1928), *Book of Bays* (1942), and *High Jungle* (1949). Beebe was born in Brooklyn, N.Y.

LORUS J. and MARGERY MILNE

BEEBREAD. See BEE (From Egg to Larva).

BEECH is a forest tree which grows both in North America and in Europe. Its thin, papery leaves turn gold colored in the autumn. The twigs are slender, and have spear-shaped buds at their tips. The male and female flowers are separate. The male flowers are in globe-shaped heads, the female in short, erect spikes. A bur covers the triangular nut, which is good to eat.

The American beech grows 50 to 75 feet (15 to 23 meters) high. A fungus began attacking beech trees in Nova Scotia about 1900. The fungus spread westward, and by the 1970's it posed a serious threat to the beech trees of New England.

Beechwood is hard, close-grained, and tough. It is used to make furniture, tool handles, and veneer. It is a good fuel. The beech family also includes oaks and chestnuts.

Scientific Classification. The American beech and the European beech belong to the beech family, *Fagaceae*. The American beech is genus *Fagus*, species *grandifolia*. The European beech is *F. sylvatica*. THEODORE W. BRETZ

See also TREE (Familiar Broadleaf and Needleleaf Trees [picture]).

BEECHAM, SIR THOMAS (1879-1961), a British conductor, became one of the world's influential musicians, even though he received little formal musical education. During a period of 40 years, he became a major force

in the musical life of Great Britain. Beecham won fame by giving vital performances, vigorously supporting music that was little-known, and by founding and financing major orchestras and opera companies.

Beecham was born in Lancashire. At 20, he organized an amateur orchestra. He had achieved world recognition when he made his U.S. debut in 1928 as guest conductor of the New York Philharmonic-Symphony



U.S. Forest Service

The American Beech has well-balanced spreading branches. It grows only in the temperate regions of the Northern Hemisphere.

J. C. Allen & Son



Beech Trees blossom early before their leaves develop fully. They have separate male flowers, right, and female flowers. Prickly nut cases, below left, cover the triangular brown beechnuts. The tree's trunk, below right, has smooth gray bark.

L. W. Brownell



U.S. Forest Service

